IN THE APPLICATION

OF

Craig R. McCrea

FOR

Thermodynamic Free Walking Beam Engine

FILED WITH

THE UNITED STATES PATENT AND TRADEMARK OFFICE

EXPRESS MAIL MAILING CERTIFICATE
Express Mail® mailing label number: EE 353 874 012 US
Date of Deposit 02 October 2003
I hereby certify that this paper or fee is being deposited with the United States Postal Service, Express Mail Post Office to Addressee® under 37 CFR 1.10 on the date indicated above and is addressed to "Mail Stop Patent Applications, Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450"

Michael I. Kroll
Attorney for Applicant

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates generally to walking beam engines and, more specifically, a free walking beam engine that generates power through the reciprocating rotary movement of at least one cylindrical housing having an interior piston that is driven therethrough by a controlled temperature differential to effect the rotation of the cylinder to alternately drive a pair of power shafts.

Walking beams have been in use since the early 1900's in oil fields, steam engines, steel fabrication plants, agriculture and other such applications requiring high torque. The walking beam concept previously relied upon the transmission of rotary movement to a linear push/pull motion due to the devices of the prior art being fixed at the power input, power output and pivot points. Conversely, the present invention has no fixed connections and is alternately supported by a pair of pivot clamps that drive their respective power shafts and relies upon the transmission of linear movement (the piston traveling within the

cylinder) to rotary motion (the pivot of the revolving cylinder driving the power shaft) to achieve its objectives.

The power input of the present invention is derived from the principles of thermodynamic differential as applied to the "Stirling heat cycle" and the work of inventor Wally Minto. The key principle of a Stirling engine is that a fixed amount of gas is sealed inside a fixed volume of space within the engine. The movement of the piston in the cylinder is manipulated by selectively raising the temperature in a specific portion of the engine with an external heat source to increase the pressure therein thus forcing the piston to move. However, Stirling engines known in the art have two pistons working conjunctively with one another while the present invention has just one piston required for the operation thereof.

Wally Minto's wonder wheel utilized a combination of thermodynamic differential and gravity to generate power by using natural resources. The original wonder wheel comprised four used propane tanks connected to the ends of two lengths of aluminum angle crossed and secured centrally to one another at a pivotal axis in a pinwheel fashion. The opposing tanks are connected to one

another with tubing to form a sealed connection and one tank of each connected pair is filled with a low-boiling liquid such as freon or propane. A reservoir containing solar heated water is disposed underneath the wheel in such a manner that the lowermost tank is totally submerged therein during that part of the wheels rotation. The water heats the liquid which then vaporizes and is forced through the tubing into the empty tank on top which then increases in weight as the weight in the lower tank decreases, thereby creating an imbalance with gravity forcing the heavier tank downwards. This cycle continues as long as the heat source remains at a sufficient temperature to vaporize the liquid within the tanks.

The present invention incorporates aspects of a walking beam, the Stirling engine and Wally Minto's wonder wheel to introduce an energy efficient means of generating mechanical energy for direct use or for conversion to electrical energy by utilizing natural resources such as solar-heated water or recovering waste heat as a power input.

Description of the Prior Art

There are other engine devices designed for operating off of power derived from natural resources or recovered waste heat. Typical of these is U.S. Patent No. 3,100,281 issued to M. J. Malik on Sept. 3, 1968.

Another patent was issued to H. J. Conrad on Aug. 25, 1970 as U.S. Patent No. 3,525,215. Yet another U.S. Patent No. 3,996,745 was issued to J. D. Davoud et al. on Dec. 14, 1976 and still yet another was issued on Nov. 15, 1977 to J. Mulder as U.S. Patent No. 4,058,382.

Another patent was issued to J. L. Liljequist on Mar. 3, 1981 as U.S. Patent No. 4,253,303. Yet another U.S. Patent No. 4,397,155 was issued to Gordon Davey on Aug. 9, 1983. Another was issued to J. S. Davey on Oct. 11, 1983 as U.S. Patent No. 4,408,456 and still yet another was issued on Feb. 17, 1987 to G. M. Benson as U.S. Patent No. 4,642,988.

G. M. Benson was issued U.S. Patent No. 4,745,749 on May 24, 1988 and U.S. Patent No. 6,195,992 was issued to A. G. Nommensen on Mar. 6, 2001.

U.S. Patent Application No. US 2001/0049938 A1 was issued to H. Urasawa et al. on Dec. 13, 2001 and Provisional Specification No. 1361979 was issued to E. H. Cooke-Yarborough on 31 July 1974.

U.S. Patent Number 3,400,281

Inventor: Marvin J. Malik

Issued: Sept. 3, 1968

An energy conversion system utilizing the Stirling cycle and an electrokinetic transducer to convert thermal energy to electrical energy. This is achieved by replacing in a conventional Stirling cycle engine the usual power piston 7 with a flexible diaphragm. The flexible diaphragm performs the power piston's functions of alternately compressing and expanding the working medium during the Stirling cycle and additionally the resultant pressure variations are used to drive an electrokinetic transducer. When the electrokinetic transducer is driven in this way an electrokinetic liquid is urged back and forth through a porous member so as to develop an alternating electric potential across the transducer's electrodes. This electric potential is used to drive a load and can also be used to drive a ; motor which in turn drives the Stirling cycle engine's displacer piston.

In an alternate construction the power piston is not replaced but is connected to a flexible diaphragm that drives the electrokinetic transducer in the same manner as the flexible diaphragm when used as a replacement for the power piston.

U.S. Patent Number 3,525,215

Inventor: Hans Joachim Conrad

Issued: Aug. 25, 1970

A machine having two counter running pistons respectively movably connected to first and second linearly movable displacer means, in which the second linearly movable displacer means has a smaller piston area and an oppositely located larger piston area the smaller piston area of which is hydraulically connected to said first displacer means while passage means establish communication between the larger piston area of said second linearly movable displacer means and a rotary displacer means.

U.S. Patent Number 3,996,745

Inventor: John Gordon Davoud et al.

Issued: Dec. 14, 1976

An improved Stirling cycle type engine is provided wherein the working fluid is a condensible fluid such as steam and a portion of the steam is condensed prior to the introduction of the steam into the cold cylinder zone. Before and/or during compression of the steam in the cold cylinder zone, water is injected in an amount equal to, greater than or less than the amount condensed.

U.S. Patent Number 4,058,382

Inventor: Jan Mulder

Issued: Nov. 15, 1977

A hot-gas reciprocating machine having a free piston, one face of which varies the volume of a working space while its other face bounds a buffer space of constant pressure. A control mechanism maintains a constant nominal central piston position by momentarily connecting the working space and the buffer space.

U.S. Patent Number 4,253,303

Inventor: Jon L. Liljequist

Issued: Mar. 3, 1981

An engine other than an internal combustion engine, and preferably one incorporating the underlying philosophy of the Stirling hot gas engine, is physically arranged to both significantly reduce its size and weight relative to earlier designs as well as reduce fluid leakage into or out of the engine's gas enclosure. Size and weight reduction are achieved in several ways including that of moving this disclosure's counterpart to the Stirling crankshaft from outside the working-gas enclosure to inside the working-gas enclosure, or at least closer thereto than in existing designs. In several embodiments of the invention, this rearrangement simultaneously eliminates a major source of fluid leakage. In some designs of this disclosure, the Stirling working-gas enclosure, which consists of a power piston and cylinder, are replaced by a somewhat different appearing and thoroughly sealed working-gas enclosure that includes a bellows, this also assisting in reducing weight. The Stirling displacer piston has also been modified both to improve efficiency and thus reduce weight. In one

configuration it houses this invention's counterpart to the conventional Stirling crankshaft, in another embodiment it is driven by and assisted in its principal function by a rotating cam element, and in all embodiments it can be modified to direct the entrapped gas along different paths or routes depending on whether it is moving toward the hot end of the gas enclosure or toward the other end.

U.S. Patent Number 4,397,155

Inventor: Gordon Davey

Issued: Aug. 9, 1983

A Stirling cycle machine in which the compressor/expander is in driving connection with a first electromagnetic unit, and in which a second electromagnetic unit is connected to the displacer and can be operated as an externally-variable control of the movements of the displacer. In one form of the invention the second unit acts as an electromagnetic damper upon movements which the displacer makes in natural response to those of the compressor. In another form of the invention the second unit positively drives the displacer and the two units are interconnected by means including a phase-shifting device whereby movements of compressor and displacer are kept of equal frequency but variable as to phase difference. Transducers sensitive to position, velocity or accelaration may improve control of the movements of compressor and displacer, and a temperature sensor associated with the "cold finger" of the displacer may further improve control of the movements of the latter.

U.S. Patent Number 4,408,456

Inventor: Jeffrey S. Rauch

Issued: Oct. 11, 1983

A power control is disclosed for a free piston Stirling engine having a hermetically sealed vessel enclosing a working space in which oscillates a displacer for circulating working gas through a heater, a regenerator and a cooler for creating a pressure wave in the working gas which acts against a power piston for a producing power stroke. The displacer includes a post mounted in a well which forms a gas spring and cooperates with the working gas pressure wave to maintain the displacer in axial reciprocating motion. The post includes a tapered portion which reciprocates opposite a proximity probe to produce a unique signal for each axial position of the displacer to provide stroke, phase and amplitude information regarding the displacer motion. A gas spring volume control is provided, controlled by the displacer sensor, for adjusting the gas spring stiffness to control the amplitude and phase of the displacer required to produce the power to meet the engine load requirements.

U.S. Patent Number 4,642,988

Inventor: Glendon M. Benson

Issued: Feb. 17, 1987

A Stirling engine design which is solar powered is disclosed. A solar receiver converts solar radiation to thermal energy, which is stored in a storage chamber. The engine includes a displacer chamber with a displacer piston which divides the chamber into hot and cold subchambers, the hot subchamber being heated by the storage chamber. A mechanism is provided for cooling the cold subchamber. The engine also includes an alternator chamber with an alternator piston which divides the chamber into working and bounce subchambers, the working subchamber being in fluid communication with the cold subchamber of the displacer. The working fluid circulates through the cold subchamber and the working subchamber and obtains heat from the storage chamber. The working fluid is displaced by the displacer piston to drive the alternator piston, and work output is obtained from the alternator piston.

U.S. Patent Number 4,745,749

Inventor: Glendon M. Benson

Issued: May 24, 1988

A Stirling engine design which is solar powered is disclosed. A solar receiver converts solar radiation to thermal energy, which is stored in a storage chamber. The engine includes a displacer chamber with a displacer piston which divides the chamber into hot and cold subchambers, the hot subchamber being heated by the storage chamber. A mechanism is provided for cooling the cold subchamber. The engine also includes an alternator chamber with an alternator piston which divides the chamber into working and bounce subchambers, the working subchamber being in fluid communication with the cold subchamber of the displacer. The working fluid circulates through the cold subchamber and the working subchamber and obtains heat from the storage chamber. The working fluid is displaced by the displacer piston to drive the alternator piston, and work output is obtained from the alternator piston.

U.S. Patent Number 6,195,992

Inventor: Arthur Charles Nommensen

Issued: Mar. 6, 2001

A Stirling cycle engine having two chambers (formed by 12-14, or 12, 15 and 16) containing a working fluid and rotatable rotor disks (10, 11) coupled to a common output power shaft (3). Each chamber has a hot zone and a cold zone, and a passage (23) leads from the hot zone in one chamber to the cold zone in the other chamber and a passage (24) leads from the hot zone in the other chamber to the cold zone in the one chamber. Each rotor disk (10, 11) has a displacer section (5) for displacing the working fluid and a turbine section (6) having turbine blades (7) arranged along its periphery. The disks (10, 11) rotate out of phase with each other and working fluid from the respective passages (23, 24) is directed to the blades (7) to rotate the disks (10, 11) when engine is in operation.

U.S. Patent Number 2001/0049938

Inventor: Hideto Urasawa et al.

Issued: Apr. 5, 1988

A stirling cycle engine whose cylinder, including a mount, can be easily fabricated and securely attached. The stirling cycle engine of the invention comprises a casing having a cylindrical portion 2; a metallic cylinder 7 coaxially inserted into the cylindrical portion 2 of the casing 1; a piston 15 inserted into the cylinder 7; a drive mechanism 16 for reciprocally driving the piston 15; and a mount 28 which is attached to an outer periphery of the cylinder 7 for fixing the cylinder 7 to the casing 1 and retaining the drive mechanism 16. The mount 28 is made of a material of low heat conductance, constructed separately from the cylinder 7. The mount 28 is attached to the outer periphery of the cylinder 7. Thus, the easier working thereof is resulted, so that the working time is shortened, to thereby improve productivity, and reduce working costs. Further, The heat from the drive mechanism 16 is less likely to transfer to the cylinder 7 via the mount 28.

U.S. Patent Number 1,361,979

Inventor: Edmund Harry Cooke-Yarborough et al.

Issued: 31 July 1974

A Stirling cycle heat engine comprising hot and cold variable volume chambers inter-communicating through a regeneratordisposed centrally between the chambers and attached to the chambers by way of a pair of movable inner walls each of which forms an inner end part of one of the walls.

SUMMARY OF THE PRESENT INVENTION

A primary object of the present invention is to provide a walking beam engine that generates mechanical power by having a pivoting cylinder alternately drive a pair of parallel power output drive shafts.

Another object of the present invention is to provide a walking beam engine that derives its power from a piston that travels from the bottom of the cylinder to the top through a thermodynamic differential applied to a working fluid contained therein.

Yet another object of the present invention is to provide a walking beam engine that receives its power input from natural means such as ambient heat, solar-heated water or recovered waste heat.

Still yet another object of the present invention is to provide a walking beam engine that is simple and easy to use.

Another object of the present invention is to provide an infusion and encapsulation platform attachment for a walking beam engine that is inexpensive to manufacture and operate.

Another object of the present invention is to provide an infusion and encapsulation platform attachment for a walking beam engine that allows easy removal of power cylinders for maintenance and upgrading or for installation of additional power cylinders to expand engine capacity.

Additional objects of the present invention will appear as the description proceeds.

The foregoing and other objects and advantages will appear from the description to follow. In the description reference is made to the accompanying drawings, which forms a part hereof, and in which is shown by way of illustration specific embodiments in which the invention may be practiced. These embodiments will be described in sufficient detail to enable those skilled in the art to practice the invention, and it is to be understood that other embodiments may be utilized and that structural changes may be made without departing from the scope of the invention. In the accompanying drawings, like reference characters designate the same or similar parts throughout the several views.

The following detailed description is, therefore, not to be taken in a limiting sense, and the scope of the present invention is best defined by the appended claims.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

In order that the invention may be more fully understood, it will now be described, by way of example, with reference to the accompanying drawing in which:

FIGURE 1 is a sequential view demonstrating the two-power stroke or four-stroke cycle of the present invention;

FIGURE 2 is a diagrammatic view of the start of the first power stroke of the present invention;

FIGURE 3 is a diagrammatic view of the end of the first power stroke of the present invention;

FIGURE 4 is a diagrammatic view of the first recovery stroke of the present invention;

FIGURE 5 is a diagrammatic view of the start of the second power stroke of the present invention;

FIGURE 6 is a diagrammatic view of the end of the second power stroke of the present invention of the present invention;

FIGURE 7 is a block diagram demonstrating the options and relationships of the primary components of the present invention; and

FIGURE 8 is a sectional view demonstrating the donut sleeve seal of the present invention.

DESCRIPTION OF THE REFERENCED NUMERALS

Turning now descriptively to the drawings, in which similar reference characters denote similar elements throughout the several views, the figures illustrate the Thermodynamic Walking Beam Engine of the present invention. With regard to the reference numerals used, the following numbering is used throughout the various drawing figures.

10 Thermodynamic Walking Beam Engine

12 housing cylinder

14 interior chamber of 12

16 first end of 12

18 second end of 12

20 first end cap

22 second end cap

24 working fluid

26 piston

28 first heat exchanger

30 second heat exchanger

31 external heat source

32 first pivot clamp

33 second pivot clamp

34 first power output shaft

36 second power output shaft

38 hydro-carbon fuel

40 butane

42 propane

44 refrigerant

45 R134A refrigerant

46 one-way drive means

48 ratchet mechanism

50 clutch mechanism

52 recovered heat waste

54 solar-heated water

56 pressurized water

58 elevated reservoir

60 nozzle

62 turbine wheel

64 generator

66 donut sleeve seal

68 cylinder housing attachment of 66

70 piston attachment of 66

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The following discussion describes in detail one embodiment of the invention (and several variations of that embodiment). This discussion should not be construed, however, as limiting the invention to those particular embodiments, practitioners skilled in the art will recognize numerous other embodiments as well. For definition of the complete scope of the invention, the reader is directed to appended claims.

FIGURE 1 is a diagrammatic view of the two-power stroke or four-stroke cycle of the present invention **10**. The present invention **10** has a four-stroke cycle including two power strokes and two recovery strokes to generate mechanical energy for direct usage or may be converted to electrical energy.

FIGURE 2 is a diagrammatic view of the start of the first power stroke. The housing cylinder **12** has end caps **20,22** on its two ends **16,18** thereby forming a sealed interior chamber **14** for retaining a working fluid **24** such as butane, propane or a refrigerant that acts upon the piston **26** when a temperature differential is present between the first end **16** and the second end **18**. Heat

exchangers **28,30** are attached to the end caps **20,22** for transmitting heat from an external heat source **31** when in contact therewith thus creating a temperature differential that increases the heat of the working fluid **24** that is proximal therewith and elevates the piston **26** to the top of the housing cylinder **12.** The weight of the piston **26** creates an unbalanced condition and the piston **26** and housing cylinder **12** begin a rotational freefall from the vertical to the horizontal position along the axis of first power output shaft **34** which is rotationally engaged with the first pivot clamp **32** of the housing cylinder **12.**

FIGURE 3 is a diagrammatic view of the end of the first power stroke of the present invention **10** demonstrating the rotational freefall of the housing cylinder **14** during the first power stroke wherein the second end **18** descends until the fall is stopped when the second pivot clamp **33** engages the second power output shaft **36.** The rotation of the housing cylinder **12** during the power stroke generates mechanical energy that is transferred as the first pivot clamp **32** drives the first power output shaft **34.**

FIGURE 4 is a diagrammatic view of the first recovery stroke of the present invention **10.** The weight of the piston **26** drops the second end **18** of

the housing cylinder **12** into the external heat source **31** as the housing cylinder **14** freewheels around the second power output shaft **36** by means of the second pivot clamp **33**.

FIGURE 5 is a diagrammatic view of the start of the second power stroke. The housing cylinder **12** has end caps **20,22** on its two ends **16,18** thereby forming a sealed interior chamber **14** for retaining a working fluid **24** such as butane, propane or a refrigerant that acts upon the piston **26** when a temperature differential is present between the second end **18** and the first end **16**. Heat exchangers **28,30** are attached to the end caps **20,22** for transmitting heat from an external heat source **31** when in contact therewith thus creating a temperature differential that increases the heat of the working fluid **24** that is proximal therewith and elevates the piston **26** to the top of the housing cylinder **12.** The weight of the piston **26** creates an unbalanced condition and the piston **26** and housing cylinder **12** begin a rotational freefall from the vertical to the horizontal position along the axis of second power output shaft **36** which is rotationally engaged with the second pivot clamp **33** of the housing cylinder **12**.

FIGURE 6 is a diagrammatic view of the end of the second power stroke of the present invention **10** demonstrating the rotational freefall of the housing cylinder **14** during the second power stroke wherein the first end **16** descends until the fall is stopped when the first pivot clamp **32** engages the first output shaft **34**. The rotation of the housing cylinder **12** during the power stroke generates mechanical energy that is transferred as the second pivot clamp **32** drives the second power output shaft **36.**

FIGURE 7 is a block diagram of the relationships and some of the options of the primary components of the present invention **10**.

FIGURE 8 is a sectional view demonstrating the donut sleeve seal **66** of the present invention **10**. The donut sleeve seal **66** provides a low friction complete seal between the alternating high pressure and lower pressure ends of the housing cylinder **12**. The donut sleeve seal **66** material is capable of withstanding refrigerant **44** or hydrocarbon fuel **38** gases and is preferably fabricated, but not limited to, a flexible rubber or plastic film or sheet in the form of a cylinder, then turned back on itself thereby forming a long "donut" extending half the length of the housing cylinder **12**. The inner sleeve portion

has a 360 degree circumferential medial attachment with the piston **26** and has a fully sealed attachment with the cylinder housing inner wall at a central location.

While certain novel features of this invention have been shown and described and are pointed out in the annexed claims, it is not intended to be limited to the details above, since it will be understood that various omissions, modifications, substitutions and changes in the forms and details of the device illustrated and in its operation can be made by those skilled in the art without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention.